MARKET MAKER V AUTOMATED ORDER BOOK MARKETS: UK EVIDENCE

ABSTRACT

The London Stock Exchange operates two separate trading platforms for UK equities: an automated limit order book (SETS) and a multiple dealer market (SEAQ). This paper examines the relative efficiency of the different market structures, by comparing the spread experienced by traders in each market.

INTRODUCTION

Market microstructure is a rapidly growing area of interest. O'Hara (1995) defines market microstructure as "the study of the process and outcomes of exchanging assets under explicit trading rules". Madhavan (2000) proclaims the importance of the area and its implications for "asset pricing, corporate finance, and international finance". Madhavan goes on to explain that "a central idea in the theory of market microstructure is that asset prices need not equal full-information expectations of value because of a variety of frictions."

There are various definitions and interpretations of market efficiency such as "security prices fully reflect all available information" (Fama, 1991) or that investors "cannot hope to consistently beat the market" (Shiller, 2000). For the purpose of this paper, "efficiency" refers to the market microstructure. Again, there are as many definitions for this as there are for market efficiency. We will define the measure of efficiency as the trading cost incurred.

There are several types of market structure. The major stock markets are either automated limit order books or dealer markets. A simple trade on an automated limit order book would involve market participants electronically entering a limit order, defining an amount and a maximum/minimum price they are willing to buy/sell. A counterparty then issues a market order to sell/buy, and is automatically matched to the limit order offering the best price. In a dealer market, there are intermediaries or market makers, willing to buy and sell at a given price for a given quantity. Investors agree a price and then trade with the market maker. There may be one or many market makers for a given stock.

While there has been a global shift from floor trading markets to automated order book markets, there is little empirical evidence to suggest that the latter is more efficient. Previous studies have looked at the transaction costs of cross listed stocks (Forster *et al,* 1996), or a batch of matched stocks (Haung and Stoll, 1996). The results are obscured by the inherent differences between the markets in question. Ideally we would like to compare stocks from the same market, that use different trading platforms.

In 1996, the London Stock Exchange (LSE) introduced SETS (Stock Exchange Trading System), an automated limit order book, for the FTSE 100 stocks. Since then, several of the FTSE 250 stocks have switched from SEAQ (Stock Exchange Automated Quotations System) to SETS. This makes possible a comparison of the trading costs to be made for the FTSE 250 constituents which trade on the different systems.

Market Architecture

Market architecture describes the physical environment and processes encountered by traders, along with the regulatory boundaries. Madhavan (2000) names 5 distinct characteristics of market architecture:

1. Market type (degree of continuity, reliance on market makers, degree of automation)
2. Price discovery (the process of information filtering through to prices)
3. Types of orders permitted (e.g. limit orders contingent on market conditions)
4. Protocols (e.g rules about program trading, trading halts, opening and closing procedures)
5. Transparency (pre and post trade, links between formal and informal markets).

There are other features of a market that affect its efficiency, but these are often harder to quantify. For example, some stocks are traded on more than one market. This competition for order flow may affect the efficiency of each market. The differences in the competing markets may also affect the cross section of informed and uninformed investors. Similarly, access to the market is important, but rarely considered in academic literature. Subscription fees may be negligible for large investment houses, but they can restrict access for private investors or smaller companies. This introduces another level of intermediation. This may affect the efficiency of the market, and it will affect the measures of efficiency, which ignores brokerage commission.

Much of the previous published research studies the NYSE (New York Stock Exchange), for a number of reasons: it is one of the most liquid markets in the world, it provides a vast quantity of accurate data, and it is one of the few existing markets to have specialist intermediation and a physical trading floor. Venkataraman (2001) describes the NYSE as an "order driven floor-based continuous market with specialist". However, like many international markets, there are different ways to trade. The NYSE is actually a hybrid market. Orders can be submitted to a floor broker or through SuperDOT to the central limit order book.

SEAQ is one of the other trading platforms that rely on market makers. The main difference between SEAQ and the NYSE is that SEAQ has multiple market makers rather than a designated specialist. Both inventory models and information based models assume that there is a single market maker, and so it is difficult to extrapolate the results to the LSE. It can be argued that competition from other market makers should make the market more efficient. However, regulators impose strict rules on NYSE specialist

firms. Specialists are punished for making too much profit, at the expense of providing liquidity.

As mentioned above, SEAQ is a multiple market maker driven market. Market makers submit their best bid and offer prices to SEAQ, and brokers can view these quotes on screen. These quotes are firm, for trades up to the quoted size (usually the Normal Market Size). Before a trade is placed, brokers can phone a market maker to confirm a price for a larger size or try to get a price improvement.

SETS is an electronic order book. Liquidity is provided by any trader placing a limit order onto the book. Member firms can view a subsection of the order book (top ten quotes on either side, and overall volume on each side), and post market orders or limit orders of their own.

Revealed Preference for Automated Limit Order Book Markets

Madhavan (2001) talks of the "revealed preference" of markets to switch to automated auction markets. Exchanges around the world have different ownership structures, e.g. the NYSE is mutually owned by the member firms, whereas the LSE is owned by shareholders. Maximising profits for the exchange ownership, and improving efficiency within the markets that the exchange provide, may not be entirely compatible objectives. An exchange makes profits as a function of the number of trades and the size of the transaction cost, the higher the better in both cases. The efficiency of the market depends on the same two variables, but the transaction cost should be minimised. This is an agency problem. The "revealed preference" for exchanges to switch to automated order books, is not evidence that these are more efficient market structures.

Amihud *et al* (1997) discover large changes in asset values when stocks moved to a more liquid trading system on the Tel Aviv Stock Exchange. This could be a result of stricter disclosure requirements, stricter regulation and so greater trust in the exchange, quicker information flow, greater publicity or other reasons. While we can say with certainty that foreign investors are less disadvantaged by physical location with an electronic limit order book rather than a physical floor trading market, we cannot conclude from this that the market is necessarily more liquid in the former case.

LITERATURE REVIEW

Venkataraman (2001) compares an automated market (Paris Bourse) and a floor trading market (NYSE). He finds that the NYSE has lower transaction costs than the Paris Bourse. This paper uses a similar methodology, but does not make the same comparison. Venkataraman compares an order book with a trading floor system. This paper compares an order book with a market maker system.

Madhavan (2001) is not sure whether it is the existence of the trading floor or the specialist, or simply human intermediation that causes the results that Venkataraman reports. Madhavan concludes that "these results suggest that the present form of the automated trading system may not fully replicate the benefits of human intermediation on a trading floor". However, he points out that many other aspects of the market structure are different including "insider trading rules, macro risk factors and overall level of market activity".

It is clear that we cannot simply test for "automation" versus "market maker" when comparing different markets, because we are looking at the whole market

microstructure. This includes the ease of trading, the ease of information flow, barriers to entry into the market, experience of professionals in the industry, technological limits and so on. Many of these issues, however, are not relevant when comparing two trading systems in the same market.

Previous work in this field examines the relative transaction costs of cross listed securities (Forster *et al,* 1996). There are many problems with this comparison as stocks usually have a main listing with most of the trading occurring in that market. The research design was later revised to compare groups of matched stocks, where matching is carried out with reference to "price, market capitalization and trading volume" (Haung and Stoll, 1996). While this allows for many of the previous criticisms, there are still significant differences including investor profile, tax, and information flow.

Information Asymmetry

Harris (2002) spells out the logical sequence: "in real markets, some traders are better informed than other traders." Well-informed traders trade quickly to profit from their information. Trades are made quickly by submitting market orders. "The well-informed traders subject the limit orders to adverse selection."

It is not clear what kind of "information" Harris is referring to. Insider trading is illegal in most markets. Information is rapidly disseminated in developed markets. Academics argue that a good analyst's interpretation of publicly available data is itself information. Information can be split into internal and external categories. Earnings announcements and other published information is external information. An analyst's valuation model is an example of internal information. A market maker's inventory level

is another example of internal information. Common interpretation may assume the analysts to be informed but the market maker to be uninformed. It should be noted that the distinction of informed and uninformed traders and the interpretation of "information" varies.

Harris lists several proxies for information asymmetry, including: information disclosure rules, analysts, information vendors, diversified portfolios, age of firm and insider trading rules. Given that most of the information vendors and all of the disclosure requirements are the same for SEAQ stocks and SETS stocks, there is no reason to believe that the information asymmetry would be different for each group of stocks.

Theory often assumes that the specialist is an uninformed liquidity trader. But Madhavan and Smidt (1993) find that "the specialist appears to possess market information unavailable to most traders; future order imbalances affect current price quotations". On the LSE, market makers may not be privy to inside information, but they do deal on their own account and frequently trade on information.

It is usually assumed that traders are either informed or uninformed, rather than having investors with varying levels of information. Glosten and Milgrom (1985) and Easley and O'Hara (1987) create models that separate traders into these two groups, but it is not clear how their models are affected by the relaxation of this assumption.

Market Makers

Cao *et al* (1997) discuss the effect of competition among exchanges, and how this affects the efficiency of a specialist in the NYSE. A similar comparison could be drawn between the competing market makers on the LSE. Cao *et al* (1997) show that there is significant

variation in the efficiency of different specialist firms. Similarly UK market makers may not be as efficient as each other or for that matter, as efficient as NYSE specialists.

Inventory theory is based on a single market maker. Stretching the conclusions to allow for multiple market makers is not straightforward. Neither is it easy to allow for the numerous liquidity providers on an order book. Grossman and Miller (1988) show that increasing the number of market makers increases the depth of the market and so increases liquidity, particularly around crashes and other anomalies.

Alternative methods of trading

Trading platforms face competition for order flow from other areas of the market (hybrid markets), off the market (privately arranged trades and retail brokers) and rival exchanges. Traders may consider several factors when choosing how to trade, including efficiency, transparency, cost, access, stability, security, familiarity and monetary incentives.

Madhavan (2001) points out that Venkataraman (2001) looks at the trading floor trades on the NYSE. This ignores the fact that a large number of trades are placed through the automated superDOT system. Haung and Stoll (1996) compare a dealer market (NASDAQ) with an auction market (NYSE). This was the first cross market comparison. While Venkataraman (2001) uses the NYSE as a specialist market, Haung and Stoll (1996) concentrate on the automated order routing of the NYSE through the DOT (now SuperDOT) system. Haung and Stoll (1996) match stocks by "price, the market value of equity, the ratio of book to market value of equity, and leverage". They

find that transaction costs are higher on NASDAQ than the NYSE, but NYSE is characterized as a limit order book market in this comparison.

Bessembinder and Kaufman (1997) also make " a comparison of trade execution costs for NYSE and NASDAQ-listed stocks". They show that the results of Haung and Stoll (1996) also hold for small cap stocks. Furthermore, they show that the higher trading cost on NASDAQ is not attributable to adverse selection, as the average price impact is similar or smaller than the NYSE sample. This uses the price impact measure which we discuss later.

Blume and Goldstein (1997) show that markets which compete with the NYSE for a given stock, "attract a significant portion of their volume when they are posting inferior bids and offers". They argue that some traders will follow the best price, but some will trade by convenience, or familiarity, or by agreements such as "paying for order flow".

It is important to understand how the market affects the trading behaviour. Biais *et al* (1995) look at the implications of trading in a transparent order book. One result is that investors place limit orders inside the spread when the depth is large, thus giving them time priority over those that follow suit. This behaviour skews the comparison of efficiency, when using the bid offer spread as a measure.

Jong *et al* (1995) compare the Paris Bourse and SEAQ International. They find that quoted spreads are lower on Paris Bourse, but that this is clouded by differences in depth. They also show that although the spread on the Paris Bourse order book is wide for large trades, actual transactions are cheaper on the Paris Bourse, presumably due to

the active upstairs markets. They also concede that "factors such as immediacy and execution risk play a crucial role".

Madhavan (1992) evaluates price discovery on a quote driven market and an order driven market. He shows mathematically that " a quote-driven system provides greater price efficiency than a continuous auction system. However with free entry into market making, the equilibria of the two mechanisms coincide". This gives us *a priori* estimates that SETS and SEAQ should be equally efficient in terms of price discovery. However, Glosten (1994) finds that for a dealer market to compete with an order book, they must offer something other than better price for a given size of trade. This could be lack of anonymity, or greater liquidity as a result of investors' reluctance to switch markets.

Block Trades

Academics and professionals believe that large block trades are usually motivated by liquidity rather than information. The ability of investors to signal large liquidity based trades has a knock on effect for the rest of the market. It is important to establish whether block trades occur on the central market and whether these trades are included in the quoted statistics.

LaPlante and Muscarella (1997) compare NASDAQ with NYSE, concentrating on block trades. They look at "(1) frequency of the sizes and types of block trades found in the two markets, (2) the immediate price effect of block transactions, and (3) the temporary and permanent price effects of blocks". They find that larger block trades are put through the NYSE, and that these incur lower losses (in terms of spread and temporary price impact) than with NASDAQ.

Haung and Stoll (1996) state that, "If one market structure is more efficient than another in protecting against informed traders, its spread will not need to be as large". Madhavan and Cheng (1997) add that "upstairs intermediation reduces the marginal costs of trading" and that the level of these costs depends on the reputation of the trader. This was first argued by Seppi (1990), saying that traders that can credibly signal liquidity motivated trades, will receive improved quotes.

Degree of Continuity

Madhavan (1992) demonstrates that "a periodic trading mechanism can function where a continuous market would fail". Amihud and Mendelson (1987) compare "the opening and closing transactions on the NYSE". The opening is characterized as a clearing house auction, while the closing is a continuous dealership market. They find that the opening prices are more volatile, rationalising that it is the trading mechanism that causes this result. However there are other timing differences, reporting requirements and behavioural finance theories to explain this as well. A comparison of SETS and SEAQ is not subject to differences in degrees of continuity, other than the different rules and processes surrounding trading halts. Trading halts are rare and beyond the scope of this paper. The comparison in this paper benefits from having a similar degree of continuity in both markets.

Pagano and Roell (1992) compare "auction and dealership markets". Interestingly they describe Paris Bourse as a hybrid trading platform, offering "a batch auction at the beginning of the trading day" and "a continuous auction" for the rest of the trading day.

Biais *et al* (1999) also discuss the preopening period on the Paris Bourse. 10% of trades occur as a result of the market opening procedure. They conclude that "the discipline provided by the occurrence of immediate trades is not necessary for markets to reach informationally efficient outcomes."

Cao *et al* (2000) show that quotes with no firm commitment to trade (i.e. market opening) do contain information for price discovery. This is supported by Madhavan and Panchapagesan (2000), who show the impact of the specialist during the opening period on the NYSE. However they qualify this by saying that a call market with specialist intervention is not necessarily superior to a transparent call market, in which every investor can see the order book, as is the case at the LSE opening for SETS stocks.

Spread and Depth

Measures of market spreads are discussed in detail in the next section. The most commonly used measure is the bid offer spread. Theory shows that there are transient and permanent components of the spread. The transient component represents the fixed cost of a transaction, and the permanent component allows for the risk of trading with an informed trader.

Madhavan (2001) asks "who pays the spread?" Liquidity providers benefit from a wider spread. Liquidity is provided by market makers and limit orders in each of the different structures. Since all investors have the option to place limit orders in an automated order book market, it is not sensible to conclude that investors benefit from a smaller spread in this market. However, informed traders who wish to trade quickly do benefit from a smaller spread.

Venkataraman (2001) discusses the importance of tick size, and shows that when the NYSE reduced the tick size for some of the stocks, the efficiency measures reduced accordingly. There are psychological theories surrounding the actual tick size, but the more important issue is the ratio of tick size to share price. The tick sizes are equal for all FTSE 250 stocks, and so the proportional tick sizes can be matched by simply matching the price of stocks. However, SEAQ trades which occur as a result of a phone call may include price improvements by something other than the tick size. Conversations with market makers suggest to me that price improvements are usually multiples of the tick size, but this still introduces another reason why the efficiency measures may differ.

Kavajecz (1999) looks at "A specialist's quoted depth and the limit order book". He describes how NYSE market makers must beat the spread to trade, because of the priority rules. Kavajecz (1999) also concludes that depths are used as a "strategic choice variable by the specialist". Madhavan and Cheng (1997) argue that "liquidity is characterized by its ability to absorb large trading volume without substantial price movements." This highlights the importance of depth in our measures of efficiency.

MEASURES OF EFFICIENCY

As mentioned before, the bid offer spread is made up of permanent and transient components. The transient component reflects the return required for providing liquidity. If we consider limit orders as contingent against a market maker, we could assume that collectively, those that place limit orders will have greater overall overheads than a single market maker. We could then conclude that the transient component of the spread would be higher for SETS. However, this assumes that placing limit orders is profitable in the

long run. The permanent component of the bid offer spread depends on information asymmetry. The comparison of SETS and SEAQ is unaffected by many of the determinants of information asymmetry.

Our measures of efficiency have been calculated in the same way as Venkataraman (2001). The first measure is:

$$\text{Percentage Quoted Spread}_{it} = 100 * (\text{Offer}_{it}-\text{Bid}_{it}) / \text{Mid}_{it}$$

Offer_{it} and Bid_{it} are the best offer and bid prices quoted by market makers on SEAQ or the best bid and offer prices shown on the SETS limit order book for a given stock (i) and trade (t). Mid_{it} is the midpoint of the offer and bid prices.

The quoted spread is averaged without weighting. The rationale behind this method is that we only care about the spread when trades take place. Other arguments could be made, and Venkataraman (2001) uses a time weighted average. However, the limitations of this measure and the computational cost outweigh the gain from calculating a time weighted average. Further discussion follows in the next section.

$$\text{Percentage Effective Spread}_{it} = 200 * D_{it} * (\text{Price}_{it} – \text{Mid}_{it}) / \text{Mid}_{it}$$

D_{it} is a dummy variable that equals 1 for a buy order and –1 for a sell order. Price_{it} is the transaction price.

$$\text{Percentage Price Impact}_{it} = 200 * D_{it} * (V_{i,t+n} – \text{Mid}_{it}) / \text{Mid}_{it}$$

$V_{i,t+n}$ is the mid price at the time of the first trade more than n minutes after the original trade. For this comparison, we have taken n to be 30 minutes. This measure was included for completeness, although the validity of this statistic is discussed later.

Finally we calculate the Percentage Realized Spread. Note that the realized spread, less the effective spread, gives us the price impact.

$$\text{Percentage Realized Spread}_{it} = 200 * D_{it} * (\text{Price}_{it} - V_{i,t+n}) / \text{Mid}_{it}$$

DATA

Data Source

The data set was obtained from the London Stock Exchange. It includes details of the best bid and offer prices quoted by SEAQ market makers and every limit order placed onto the SETS order book. Each quote is time stamped to the nearest second. A separate data set records every trade with a time stamp to the nearest second, along with the quantity, price, participant codes, and whether it was a buy or sell initiated trade. These two data sets have been combined to show the quoted spreads at the time of each trade.

Data Validation

Timing of trades is vital for the comparison and so trades reported late were also excluded from the sample. Inspection of the data also highlighted errors. Occasionally prices were typed with the decimal point in the wrong place, or the figures were reversed, or the figures were simply implausible. The incidence of obvious errors in the data were small (less than 1%), and so they were simply deleted from the sample if:

1. A buy order occurred at more than 10% away from the market offer price.
2. A sell order occurred at more than 10% away from the market bid price.

While there is no official dealer market for SETS stocks, a significant proportion of trades occur away from the order book. These are trades organised with retail brokers or transactions between brokerage firms. Proportions of trade types are shown in Table

1. This paper compares the market makers and an automated order book, and so only the trades on the order book have been included in the SETS sample.

This issue was addressed by Venkataraman (2001). He states that on the NYSE, only 5% of trades and 42% of the share volume go through the trading floor. Madhavan and Sofianos (1998) show that at the NYSE, specialists take part in 54.1% of trades in illiquid stocks, but only 15.4% in liquid stocks. In contrast, at the LSE, we find that the proportion of automated trades increase with liquidity. There are a number of explanations for this. The LSE statistic was calculated for trades in September 1998. At this time, the illiquid stocks (FTSE 250) had more recently swapped over to SETS. Market participants have shown a reluctance to switch trading systems, and so a lower proportion of trades went through the order book for the more recent additions to SETS.

SEAQ trades were matched up with the transaction reports, to identify the presence of a market maker in the trade. All trades with a market maker on one and only one side of the trade were included.

Matching

All FTSE 250 stocks trading on SETS at 1 September 1998 were matched with FTSE 250 stocks trading on SEAQ. Certain stocks were excluded from the list of potential matches. Companies that changed trading platform were excluded. Companies that delisted, went bankrupt, were taken over or merged during the period were excluded. This was done to simplify calculations. There is no reason to believe that this introduces a bias.

While the FTSE 250 constituents trading on SETS tend to be the larger companies, it is possible to match pairs of companies using the same method as Venkataraman (2001). Venkataraman uses 4 different algorithms:

1. Price and Market Capitalization.
2. Price and Trading Volume.
3. Industry, Price and Market Capitalization.
4. Industry, Price and Trading Volume.

Trading Volume is calculated as the total trading volume reported to the exchange throughout the period of review. This includes the trades that occurred away from the SETS order book, or the SEAQ market makers. Trading volume in this context is a proxy for liquidity, and so it is sensible to look at all methods of trading rather than the subset of trades that we are concentrating on.

Market Capitalization is calculated at the start of the period of study. Perhaps it would be more appropriate to average market capitalization over the period, but the opening figure is used, to be consistent with Venkataraman (2001). This is unlikely to make any significant difference to the results.

Matching by industry is harder for FTSE stocks than many other markets, as the subdivision is much finer (by the FTSE Actuaries All Share classification). Where possible, we have matched stocks by sub sector, but if no stock was available, we have used stocks from the same sector. In a few cases, this has meant matching the likes of a tobacco company with a health company. The purpose of matching by industry is to account for trends in demand. While stocks in the same sector have similar characteristics, there are reasons why share prices would move together, e.g. change in

raw material cost, but also apart, e.g. one company signs an important contract. Given the matching errors already introduced, it is reasonable to allow this slight deviation from the original research design. One exception to this rule is that of financials: investment trusts were not matched against other financials, as these have very different performance characteristics.

An Average Deviation statistic was calculated for each pair of stocks. For the first comparison, the average deviation is calculated as:

$$[\,[(Price_q - Price_t) / (Price_q + Price_t)] / 2 \; + \; [(MC_q - MC_t) / (MC_q + MC_t)] \; / \; 2\,] \; / 2$$

where MC is the market capitailzation and the subscripts q and t refer to SEAQ and SETS resepectively. Each pair with an average deviation greater than 0.75, was excluded. Haung and Stoll (1996) sum over the square of the characteristic deviation, rather than simply sum, but we have used the method of Venkataraman (2001) for consistency.

Research Design

Having matched the stocks into appropriate pairs, we collate the two samples: SEAQ and SETS. Each of the efficiency measures is averaged over each month in the sample. Each of the trade dependent measures is subdivided into the size of the trade:

£50,000 <	Very large	
£10,000 <	Large	< £50,000
£5,000 <	Medium	< £10,000
£1,000 <	Small	< £5,000
	Very small	< £1,000

These data points were then averaged over the year, and averaged over each stock for each of the samples.

RESULTS

The full table of results is shown in Table 3. Overall the efficiency measures are higher (less efficient) than the NYSE and the Paris Bourse. This is because we are looking at less liquid stocks of the LSE. Also worth noting is that the time period is different. Chordia *et al* (2001) state that "effective spreads respond to equity market returns, recent market trends and recent market volatility".

Quoted Spread

The results show significantly higher quoted spreads on SEAQ. This is the opposite result to Venkataraman (2001). However there are several reasons why the quoted spread should not be used to compare SEAQ with SETS. Firstly, there are always opportunities for price improvement from SEAQ market makers, but what you see is what you get on the limit order book. Secondly, the quoted spread on SEAQ is usually quoted for normal market size, while the spread on the limit order book could be quoted for any quantity. For example, it is not uncommon for traders to front run the spread with small volume quotes. This would understate the "realistic" spread. Thirdly, there is no generally accepted method to cope with the fact that trades occur at different times than quote revisions i.e. is it appropriate to evaluate the efficiency of trading with a measure that doesn't involve any aspect of a trade?

Effective Spread

Overall, the effective spreads are larger on SEAQ than on SETS, for each matching algorithm. This result contradicts Venkataraman (2001). Based on these figures it would appear that on the LSE, the order book is a more efficient trading platform.

The difference is largest for small trades (£1,000 - £4,999) and decreases with size. For very large trades (> £50,000), transactions on SEAQ have a lower incurred cost. This can be rationalised by the proportion of investors trading through the order book. For SETS stocks, uninformed traders of large volume will take their business to brokers off the market. This is not the case for SEAQ stocks. This means that on average, we might expect large trades on the order book to contain more information than large trades on SEAQ.

We have used the absolute size to categorize trades. It could be argued that the relative size is more important, i.e. we should compare the percentage of a company being traded in any given transaction. Two out of the four samples are matched using market capitalization. This makes an approximate allowance for the relative size of trades, although the results will be weighted unevenly between stocks. Market capitalization varies from £79million to £3695million, for the sample matched on price and market capitalization. It is clear that a relatively large trade for the former and a relatively small trade in the latter, may both be categorized as a medium trade on our scale. This approach was chosen for consistency with previous studies, but the shortcomings should be noted.

It is also worth noting that the trading mechanism may have an impact on trading strategy. Breaking a large trade into smaller chunks and spreading them over time, or between market makers may be sensible on SEAQ, but there is no obvious advantage in splitting orders when submitting to SETS. This shouldn't cause much of a problem to our analysis as we have categorized the statistics by size of trade. However, if information content varies with size of trade, and the mechanism affects the trading strategy, a bias will be introduced.

The figures vary between matching algorithms, particularly those that ignore the industry of each firm. However, the differences all have the same sign, and the trend by size is observed for each method.

Price Impact

The results are mixed and volatile. The price impact, for medium trades particularly, varies across each sample. In some cases, we see a negative price impact, i.e. a medium sized buy order implies that the price will go down. Ignoring the size of trade, the price impact is always positive, and the price impact is always greater for SETS. There are several explanations and problems with these statistics. These are discussed below.

It is difficult to choose a time scale for this measure. The shorter the time scale, the bigger the impact of the size of the trade (informed trade or not), and the longer the time scale the more information from other sources and trades. I have used 30 minutes, to be consistent with Venkataraman (2001). Given that Venkataraman studies the most liquid stocks on the Paris Bourse and the NYSE, and I am studying the less liquid FTSE

250 stocks, it may be appropriate to use a longer time scale. A market maker in a SEAQ stock may decide not to change the spread for several hours. This may introduce a bias.

Venkataraman (2001) uses Price Impact as a measure of information content of a trade. This may not be appropriate. Firstly investors with information are unlikely to have information that will be leaked out and be fully reflected in the share price within 30 minutes. Secondly, it is more useful to look at the other means of trading to ascertain the level of information in the market. Theory (or common sense) suggests that rational investors would use an anonymous market, where available, to hide their trades. This implies that NYSE investors would route their orders through SuperDOT rather than through a floor broker. In Paris, uninformed block traders would use the upstairs market to execute trades. And so, intuition tells us that there should be a higher proportion of information in the trades on the Paris Bourse. This relies on two assumptions: there are similar percentages of informed and uninformed investors in each market, and the market microstructure is efficient enough, so as not to dissuade many informed investors. Applying this logic to the LSE implies more information in SETS trades than SEAQ trades.

Having qualified the use of these results, it appears that SEAQ is more efficient than SETS on this measure. The fact that SEAQ would be more efficient on one of the four measures could mean a number of things: the efficiency measure is inappropriate, the results are biased in some way or the results are prone to random error.

It is possible that market makers are less concerned about updating quoted prices, since most trades occur within the spread. This would bias the result, as price

improvements would be so long after the event that they would be more likely to include information from other sources.

On the other side, market orders, which take liquidity from the market, may automatically change the spread. A large enough buy order (larger than the quoted depth) will increase the spread immediately. This does not dictate how other investors will react, but it explains what the observed prices will do in the short term.

Realized Spread

This is the impact of the trade on the mid price over a thirty minute time period. Haung and Stoll (1996) use the difference between the realized spread and the effective spread as a measure of adverse information. Ignoring the difference in averaging, this is effectively what the "price impact" measured in the previous section. Again, the issues described above, apply equally here.

We find that the realized spread is higher for SEAQ than SETS. This may imply that the impact of the effective spread is greater than the impact of the change in mid price, but more likely it is a result of differences in the data between the two samples.

CHANGING FROM SEAQ TO SETS

Following a LSE review, it was decided to allow more FTSE 250 stocks to switch from SEAQ to SETS on 6 September 1999. SETS was intended for the more liquid stocks, and there was an element of status associated with stocks added to this trading platform. Amihud *et al* (1997) showed how stock prices jumped when introduced to a more liquid

market structure. For our comparison, we must evaluate whether the switch from SEAQ to SETS added liquidity or not.

Research design

We look at the two year period 1 September 1998 to 31 August 2000. We calculate each of the efficiency measures for each stock, for each year. We split stocks into three groups: those that switched on 6 September 1999, those that traded on SEAQ for the two year period, and those that traded on SETS for the two year period. There is no need to match stocks in terms of market characteristics, as we are only comparing the change from year one to year two, for each group.

Results

Despite the changes in market conditions, in particular the beginning of the bear period in year two, we see that the efficiency measures for those stocks that did not switch platform are relatively stable. In contrast, the spreads calculated for those that did switch, do change significantly. The quoted spread increases considerably, but this is unlikely to be a good indication. The problems interpreting the price impact and realized spread apply equally to this situation. However, the increase in effective spread from year one to year two cannot be explained by data manipulation problems.

The effective spreads for the two samples that did not involve a change in trading platform, decrease from year one to year two. In the case of the SETS stocks, the spread decreases by 6 basis points. In contrast, the effective spread for those that switched increased by almost 7 basis points. This may be explained by the proportion of informed

trading in the market. We might expect high volume, uninformed traders to trade away from the limit order book, leaving a greater proportion of the informed traders trading in the market. This result may also be due to the reluctance of traders to use the new system for these stocks. This would artificially reduce the volume of trading in the central market. However, irrespective of the rationale, we have shown that stocks which switched from SEAQ to SETS experienced an increases in transaction cost. Given the strong link between our definition of efficiency and most other definitions of liquidity, this result implies that switching from SEAQ to SETS leads to an increased liquidity risk premium, and a decrease in stock price.

This result provides as many questions as answers. A further study could look at the long term effects, by regressing the transaction costs on each stock, using the length of time that the stock has been traded on SETS, and the length of time since SETS was introduced. This would measure the reluctance of traders to switch platform, and how attitudes have changed over time.

A MEASURE OF INFORMATION CONTENT: INVESTMENT TRUSTS

Efficient markets rely on traders inferring information from trades. One of the many challenges faced by investors is to separate the effects of implied information and actual information. Similarly, it is difficult to measure the efficiency of a market by analysing the effects of (so-called) informed trades on the price formation process. As discussed earlier, any measure that looks at the profitability of trades over a short time scale will include the effects of actual information as well as implied information.

Harris (2002) notes that "spreads … should be widest for instruments that most traders cannot easily value", and also that traders are more likely to have useful information about a given stock than a diversified portfolio of stocks. Therefore, the information content of trades in a diversified portfolio such as investment trust shares, should be lower than for individual stocks. If this is the case, we can test the suitability of the price impact measure as a proxy for information asymmetry.

Research Design

We repeat the process from above, matching the investment trust shares with other FTSE 250 companies. All of the investment trusts trade on SEAQ, and so the matched sample also trades on SEAQ. We chose the Price and Market Capitalization algorithm. It was easier to match stocks in this test, and so the maximum average deviation was reduced from 0.75, as was the case in Venkataraman (2001), to 0.375. The matched sample is shown in Table 5.

Results

The motivation for this study is to examine the price impact for each sample, and determine whether it is a useful measure of the information content of trades. At first glance we can see that the price impact is fairly low. As before, the price impact increases with size of trade. The difference between samples also widens with size, up to large trades, and then decreases again for very large trades. This supports the use of price impact as a measure of information asymmetry, but the weakness in the statistics highlights the limitations for analysis in less liquid stocks like the FTSE 250.

Equally significant is the differences in quoted and effective spread. As we are comparing stocks trading on the same platform, the quoted spread makes for a valid comparison. All measures are substantially lower for the investment trust sample. This may be due to the lower risk of informed traders. If this is the case, then the effective spread appears to be a stronger indicator than the measured price impact.

CONCLUSION

There are several aspects to the design of a market. Given the limited number of comparable exchanges, it is difficult to evaluate the effect of just one aspect. Comparisons of cross listed securities ignore the differences in the amount traded on each market. Comparisons of matched stocks on different markets ignore, the investor profile, tax and information flow. Comparisons of market opening with normal trading on the same market are distorted by the time lags in information flow and quote revision. The comparison in this paper improves on all of these issues, by comparing different trading platforms in the same country, in the same market, with the same investors and that trade at the same time.

The aim of this paper was to replicate the study by Venkataraman (2001) in a different market and either support or dispute the previous conclusions. Overall the results contradict those of Venkataraman, showing that transaction costs on the limit order book are higher than the dealer market. Furthermore, the methodology and assumption have been scrutinised.

We have shown that stocks switching from SEAQ to SETS experienced a drop in liquidity. This poses the question of why companies would wish to switch platforms,

from SEAQ to SETS. Perhaps the long term impact of switching platforms is a more positive one. And this is an area for further research.

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Table 1: Breakdown of types of trade executed in each market

FTSE 250 SEAQ

September 1998			July 2002	
Number of Trades	Trading Volume		Number of Trades	Trading Volume
52.75	87.42	Ordinary Trades	54.70	88.69
11.07	1.82	Protected Transactions	16.35	1.86
15.98	2.07	Single Protected Transaction	12.03	2.09
7.04	4.61	Market Maker to Market Maker	4.52	3.30
6.06	0.91	Cross at same price	6.56	0.76
4.85	2.69	Non Protected Portfolio	4.32	2.77
2.25	0.49	Other Trades	1.50	0.53

FTSE 250 SETS

September 1998			July 2002	
Number of Trades	Trading Volume		Number of Trades	Trading Volume
18.22	31.20	Automatically Executed Trades	23.94	52.08
61.89	64.50	Ordinary Trades	58.07	44.18
9.22	0.89	Cross at same price	6.20	0.42
4.57	0.17	Worked Principal Trade	2.44	0.06
3.82	2.71	Non Protected Portfolio	5.05	1.41
1.38	0.15	Protected Portfolio	0.77	0.11
0.43	0.17	Volume Weighted Average Price	2.49	0.17
0.46	0.21	Other Trades	1.04	1.57

FTSE 100 SETS

September 1998			July 2002	
Number of Trades	Trading Volume		Number of Trades	Trading Volume
27.31	53.26	Automatically Executed Trades	36.41	65.23
56.95	44.59	Ordinary Trades	47.88	30.95
3.56	0.29	Cross at same price	1.58	0.17
4.26	0.09	Worked Principal Trade	0.68	0.01
5.60	1.55	Non Protected Portfolio	3.57	0.75
1.22	0.05	Protected Portfolio	0.72	0.05
0.86	0.10	Volume Weighted Average Price	6.99	0.31
0.25	0.06	Other Trades	2.18	2.53

Table 2: Matched Samples

Sample matched by price and market capitalization

Stock	Sub Sector	Sector	Price	Market Capitalization	Deviation	Price	Market Capitalization	Stock	Sub sector	Sector
BPB	Building & Construction Materials	Basic Industries	2.3	1486.69	0.121	2.525	1281.07	AVIS EUROPE	Transport	C Services
BR.STEEL	Steel & other metals	Basic Industries	0.895	2080.05	0.224	1.055	1563.17	COCA-COLA BEV.	Food Producers & Processors	NC Consumer Goods
BRITANNIC	Life Assurance	Financials	12.48	2329.98	0.546	11.515	765.59	SERCO GRP.	Support Services	C Services
CMG	Software & Computer Services	Information Technology	16	2146.01	0.596	11.15	882.82	NAT.EXPRESS	Transport	C Services
ELECTROCOMPS.	Distribution	C Services	3.935	1610.93	0.018	3.86	1585.41	AIRTOURS		C Services
EMAP	Media & Photography	C Services	11.33	2128.53	0.222	11.625	1393.34	PENNON GROUP	Utilities Other	Utilities
GALLAHER GRP.	Tobacco	NC Consumer Goods	4.0875	2508.15	0.438	4.795	1183.71	SMITH(WH)GRP.	General Retailers	C Services
LONRHO	Diversified Industries	General Industries	3.25	79.57	0.589	5.05	173.87	WILSON BOWDEN	Construction & Building Materials	Basic Industries
MEPC	Real Estate	Financials	4	1733.97	0.092	3.95	1459.31	FIRSTGROUP	Transport	C Services
NEXT	General Retailers	C Services	4.825	1673.63	0.174	3.71	1533.42	BBA GRP.	Transport	C Services
NTHN.ROCK	Banks	Financials	5.55	2255.52	0.044	5.525	2454.04	YORK.WATER	Water	Utilities
PROVIDENT FIN.	Speciality & Other Finance	Financials	8.7	2307.36	0.574	5.225	1177.14	LOGICA	Software & Computer Services	Information Technology
RANK GRP.	Leisure Entertainment & Hotels	C Services	2.275	2101.29	0.358	2.355	1033.56	BUNZL	Support Services	C Services
RMC GRP.	Construction & Building Materials	Basic Industries	8.2	2049.12	0.479	8.375	742	SETON SCHOLL	Health	NC Consumer Goods
SMITH&NEPHEW	Health	NC Consumer Goods	1.8	1569.66	0.255	1.68	1003.13	REXAM	Support Services	C Services
TARMAC	Construction & Building Materials	Basic Industries	1.135	733.74	0.081	1.02	693.66	CARADON		
TATE & LYLE	Food Producers & Processors	NC Consumer Goods	3.4	2005.86	0.254	3.575	1258.07	DEBENHAMS	General Retailers	C Services
TI GRP.	Engineering & Machinery	General Industries	3.175	1823.58	0.083	2.79	1891.25	MORRISON (WM)	Food & Drug Retailers	NC Services
UTD.BISCUITS	Food Producers & Processors	NC Consumer Goods	2.385	943.44	0.033	2.375	1003.19	IMI	Engineering & Machinery	General Industries
WOLSELEY	Construction & Building Materials	Basic Industries	3.7	3695.38	0.164	2.66	3695.38	VAUX GRP.	Brewing	NC Consumer Goods
IMP.TOBACCO GRP	Tobacco	NC Consumer Goods	6.3	2750.13	0.399	5.66	1337.82	ALLIANCE UNICHM	Health	NC Consumer Goods
		Sum	89.7275	14798.29	1.605	92.765	14368.9			
		Average	3.9011957	643.403913	0.070	4.033261	624.7347826			

Sample matched by price and trading volume

Stock	Sub Sector	Sector	Price	Trading Volume	Deviation	Price	Trading Volume	Stock	Sub sector	Sector
BPB	ding & struction Materials	Basic Industries	2.3	1.074462891	0.114	2.355	0.87456086	BUNZL	Support Services	C Services
BR.STEEL	Steel & other metals	Basic Industries	0.895	3.27053492	0.601	0.8775	0.841124999	AEGIS GRP.	Media & Photography	C Services
BRITANNIC	Life Assurance	Financials	12.48	0.468589259	0.122	11.65	0.558228903	ADMIRAL	Support Services	C Services
CMG	Software & Computer Services	Information Technology	16	0.987446064	0.188	11.625	0.929927233	PENNON GROUP	Utilities Other	Utilities
ELECTROCOMPS.	Distribution	C Services	3.935	0.995467407	0.214	3.78	0.672449439	ARRIVA	Transport	C Services
EMAP	Media & Photography	C Services	11.33	1.782674771	0.616	11.515	0.434605934	SERCO GRP.	Support Services	C Services
GALLAHER GRP.	Tobacco	NC Consumer Goods	4.0875	1.845213228	0.080	3.71	1.733375261	BBA GRP.	Transport	C Services
LASMO ORD.	Oil Exploration & Production	Resources	1.035	1.803715584	0.331	1.345	1.200772151	FKI	Engineering & Machinery	General Industries
LONRHO	Diversified Industries	General Industries	3.25	0.614323893	0.103	3.49	0.703307395	BOWTHORPE		
MEPC	Real Estate	Financials	4	0.832739705	0.050	4.055	0.907551422	JOHNSON,MATTH.	Chemicals	Basic Industries
NEXT	General Retailers	C Services	4.825	2.808143842	0.105	5.225	2.464911923	LOGICA	Software & Computer Services	Information Technology
NTHN.ROCK	Banks	Financials	5.55	1.66634426	0.138	5.525	1.268148292	YORK.WATER	Water	Utilities
PROVIDENT FIN.	Speciality & Other Finance	Financials	8.7	1.038403059	0.080	8.375	0.919071376	SETON SCHOLL	Health	NC Consumer Goods
RANK GRP.	Leisure Entertainment & Hotels	C Services	2.275	1.207253629	0.036	2.375	1.173304286	IMI	Engineering & Machinery	General Industries
RMC GRP.	Construction & Building Materials	Basic Industries	8.2	1.422795141	0.263	4.795	1.424812627	SMITH(WH)GRP.	General Retailers	C Services
SMITH&NEPHEW	Health	NC Consumer Goods	1.8	0.979000484	0.200	1.68	0.701132035	REXAM	Support Services	C Services
TARMAC	Construction & Building Materials	Basic Industries	1.135	0.668789343	0.050	1.055	0.651108284	COCA-COLA BEV.	Food Producers & Processors	NC Consumer Goods
TATE & LYLE	Food Producers & Processors	NC Consumer Goods	3.4	0.855021038	0.062	3.475	0.771227843	HAMMERSON	Real Estate	Financials
TI GRP.	Engineering & Machinery	General Industries	3.175	1.556880441	0.110	3.575	1.407857109	DEBENHAMS	General Retailers	C Services
UTD.BISCUITS	Food Producers & Processors	NC Consumer Goods	2.385	0.57584338	0.060	2.235	0.544441737	MANCHESTER UTD.	Leisure Entertainment & Hotels	C Services
WOLSELEY	Construction & Building Materials	Basic Industries	3.7	1.290995809	0.039	3.95	1.274752853	FIRSTGROUP	Transport	C Services
BLUE CIRCLE	Construction & Building Materials	Basic Industries	3.1	1.987107112	0.142	3.86	2.12276373	AIRTOURS		C Services
BURMAH CAST.	Oil & Gas	Resources	8.77	0.885525522	0.167	11.15	0.805694851	NAT.EXPRESS	Transport	C Services

DAILY MAIL'A'	Media & Photography	C Services	28.05	0.876719746	0.729	5.8	0.759868139	PSION	Electronic & Electrical Equipment	General Industries
ENTERPRISE OIL	Oil Exploration & Production	Resources	3.05	1.779422415	0.390	2.83	0.851649447	ASS.BR.PORTS	Transport	C Services
IMP.TOBACCO GRP	Tobacco	NC Consumer Goods	6.3	2.860974176	0.612	5.525	0.838895439	CAPITA GROUP	Support Services	C Services
		sum	153.7275	36.13438712	5.601	125.8325	26.83554357			
		average	5.9125962	1.38978412	0.215	4.839712	1.032136291			

Sample matched by industry, price and market capitalization

Stock	Sub Sector	Sector	Price	Market Capitalization	Deviation	Price	Market Capitalization	Stock	Sub sector	Sector
BPB	Building & Construction Materials	Basic Industries	2.3	1486.69	0.607	2.32	368.18	BARRATT DEVEL.	Construction & Building Materials	Basic Industries
BR.STEEL	Metals	Basic Industries	0.895	2080.05	0.638	0.6925	674.86	AGGREGATE IND.	Construction & Building Materials	Basic Industries
ELECTROCOMPS.	Distribution	C Services	3.935	1610.93	0.018	3.86	1585.41	AIRTOURS		C Services
EMAP	Media & Photography	C Services	11.33	2128.53	0.730	6.055	855.41	FLEXTECH	Media & Photography	C Services
GALLAHER GRP.	Tobacco	NC Consumer Goods	4.0875	2508.15	0.403	2.66	3695.38	VAUX GRP.	Brewing	NC Consumer Goods
LONRHO	Diversified Industries	General Industries	3.25	79.57	0.650	1.815	171.58	VICKERS	Engineering & Machinery	General Industries
MEPC	Real Estate	Financials	4	1733.97	0.271	3.475	1154.24	HAMMERSON	Real Estate	Financials
NEXT	General Retailers	C Services	4.825	1673.63	0.175	4.795	1183.71	SMITH(WH)GRP.	General Retailers	C Services
NTHN.ROCK	Banks	Financials	5.55	2255.52	0.537	5.475	693.2	CLOSE BROS.	Speciality & Other Finance	Financials
PROVIDENT FIN.	Speciality & Other Finance	Financials	8.7	2307.36	0.671	6.4	730.55	CATTLES	Speciality & Other Finance	Financials
RANK GRP.	Leisure Entertainment & Hotels	C Services	2.275	2101.29	0.682	2.235	410.44	MANCHESTER UTD.	Leisure Entertainment & Hotels	C Services
SMITH&NEPHEW	Health	NC Consumer Goods	1.8	1569.66	0.263	1.055	1563.17	COCA-COLA BEV.	Food Producers & Processors	NC Consumer Goods
TARMAC	Construction & Building Materials	Basic Industries	1.135	733.74	0.220	1.38	573.43	ASHTEAD GRP.	Construction & Building Materials	Basic Industries
TATE & LYLE	Food Producers & Processors	NC Consumer Goods	3.4	2005.86	0.418	2.66	3695.38	VAUX GRP.	Brewing	NC Consumer Goods
TI GRP.	Engineering & Machinery	General Industries	3.175	1823.58	0.434	2.375	1003.19	IMI	Engineering & Machinery	General Industries
UTD.BISCUITS	Food Producers & Processors	NC Consumer Goods	2.385	943.44	0.310	1.405	1044.99	NTHN.FOODS	Food Producers & Processors	NC Consumer Goods
WOLSELEY	Construction & Building Materials	Basic Industries	3.7	3695.38	0.685	4.055	813.84	JOHNSON,MATTH.	Chemicals	Basic Industries
IMP.TOBACCO GRP	Tobacco	NC Consumer Goods	6.3	2750.13	0.399	5.66	1337.82	ALLIANCE UNICHM	Health	NC Consumer Goods
		sum	73.0425	33487.48	8.110	58.3725	21554.78			
		average	4.0579167	1860.415556	0.451	3.242917	1197.487778			

Sample matched by industry, price and trading volume

Stock	Sub Sector	Sector	Price	Trading Volume	Deviation	Price	Trading Volume	Stock	Sub sector	Sector
BPB	Building & Construction Materials	Basic Industries	2.3	1.074462891	0.176	2.32	0.759580787	BARRATT DEVEL.	Construction & Building Materials	Basic Industries
BR.STEEL	Steel & other metals	Basic Industries	0.895	3.27053492	0.705	0.6	1.069231268	PILKINGTON	Construction & Building Materials	Basic Industries
BRITANNIC	Life Assurance	Financials	12.48	0.468589259	0.377	6.4	0.522863795	CATTLES	Speciality & Other Finance	Financials
ELECTROCOMPS.	Distribution	C Services	3.935	0.995467407	0.125	3.95	1.274752853	FIRSTGROUP	Transport	C Services
EMAP	Media & Photography	C Services	11.33	1.782674771	0.385	11.15	0.805694851	NAT.EXPRESS	Transport	C Services
GALLAHER GRP.	Tobacco	NC Consumer Goods	4.0875	1.845213228	0.679	8.375	0.919071376	SETON SCHOLL	Health	NC Consumer Goods
LASMO ORD.	Oil Exploration & Production	Resources	1.035	1.803715584	0.483	1	0.657741832	BR.BORNEO OIL	Oil & Gas	Resources
LONRHO	Diversified Industries	General Industries	3.25	0.614323893	0.081	2.78	0.610650224	MORGAN CR.	Engineering & Machinery	General Industries
MEPC	Real Estate	Financials	4	0.832739705	0.109	3.475	0.771227843	HAMMERSON	Real Estate	Financials
NEXT	General Retailers	C Services	4.825	2.808143842	0.330	4.795	1.424812627	SMITH(WH)GRP.	General Retailers	C Services
NTHN.ROCK	Banks	Financials	5.55	1.66634426	0.534	5.48	0.515916628	ELECTRA INV.TST	Investment Companies	Financials
PROVIDENT FIN.	Speciality & Other Finance	Financials	8.7	1.038403059	0.483	6.4	0.522863795	CATTLES	Speciality & Other Finance	Financials
RANK GRP.	Leisure Entertainment & Hotels	C Services	2.275	1.207253629	0.387	2.235	0.544441737	MANCHESTER UTD.	Leisure Entertainment & Hotels	C Services
RMC GRP.	Construction & Building Materials	Basic Industries	8.2	1.422795141	0.559	4.055	0.907551422	JOHNSON,MATTH.	Chemicals	Basic Industries
SMITH&NEPHEW	Health	NC Consumer Goods	1.8	0.979000484	0.678	8.375	0.919071376	SETON SCHOLL	Health	NC Consumer Goods
TARMAC	Construction & Building Materials	Basic Industries	1.135	0.668789343	0.122	1.1	0.540320807	WIMPEY(GEO)	Construction & Building Materials	Basic Industries
TATE & LYLE	Food Producers & Processors	NC Consumer Goods	3.4	0.855021038	0.485	1.405	0.74288043	NTHN.FOODS	Food Producers & Processors	NC Consumer Goods
TI GRP.	Engineering & Machinery	General Industries	3.175	1.556880441	0.285	2.375	1.173304286	IMI	Engineering & Machinery	General Industries
UTD.BISCUITS	Food Producers & Processors	NC Consumer Goods	2.385	0.57584338	0.216	1.665	0.533005635	GLYNWED INTL.	Food Producers & Processors	NC Consumer Goods
WOLSELEY	Construction & Building Materials	Basic Industries	3.7	1.290995809	0.482	4.38	0.555619158	BERKELEY GRP.	Construction & Building Materials	Basic Industries
BLUE CIRCLE	Construction & Building Materials	Basic Industries	3.1	1.987107112	0.506	4.055	0.907551422	JOHNSON,MATTH.	Chemicals	Basic Industries
DAILY MAIL'A'	Media & Photography	C Services	28.05	0.876719746	0.635	11.65	0.558228903	ADMIRAL	Support Services	C Services
IMP.TOBACCO GRP	Tobacco	NC Consumer Goods	6.3	2.860974176	0.734	5.66	0.544573592	ALLIANCE UNICHM	Health	NC Consumer Goods
		sum	125.9075	32.48199312	9.555	103.68	17.78095665			
		average	5.4742391	1.41226057	0.415	4.507826	0.773085072			

Table 3: Transaction cost measures, broken down by size of trade

		Industry, Price and Trading Volume			Industry, Price and Market Capitalization			Price and Trading Volume			Price and Market Capitalization		
		SETS	SEAQ	diff	SETS	SEAQ	diff	SETS	SEAQ	diff	SETS	SEAQ	diff
Quoted Spread	OVERALL	84.11	139.81	55.70	84.42	134.41	49.99	84.64	165.27	80.63	82.25	149.50	67.25
Effective Spread	very small	95.69	104.52	8.83	98.04	102.76	4.72	97.39	125.69	28.30	96.39	111.57	15.18
	small	88.74	99.40	10.66	89.58	99.31	9.73	88.23	122.75	34.51	89.30	107.04	17.74
	medium	90.00	95.15	5.15	90.86	96.05	5.19	84.35	117.62	33.28	90.28	103.39	13.11
	large	82.91	87.10	4.19	82.49	87.52	5.03	78.99	106.32	27.34	82.76	95.61	12.85
	very large	81.61	52.28	-29.34	81.13	51.80	-29.33	80.49	60.01	-20.48	80.90	55.98	-24.92
	OVERALL	81.85	89.76	7.91	80.80	88.28	7.48	78.34	109.43	31.09	80.47	97.94	17.47
Price Impact	very small	14.83	-19.02	-33.85	12.13	-14.66	-26.79	12.61	4.74	-7.87	9.17	5.66	-3.51
	small	24.50	-24.17	-48.68	26.35	-18.57	-44.91	27.54	8.51	-19.03	26.52	6.44	-20.08
	medium	25.40	11.85	-13.55	-139.7	13.08	152.74	-223.3	-125.77	97.54	-161.6	12.20	173.83
	large	39.72	67.84	28.12	82.50	60.97	-21.53	112.68	32.65	-80.03	88.82	28.14	-60.69
	very large	47.13	22.58	-24.55	45.95	23.60	-22.35	50.88	25.24	-25.64	46.96	24.64	-22.32
	OVERALL	34.19	8.45	-25.75	34.08	10.87	-23.21	39.78	0.81	-38.98	33.74	15.96	-17.78
Realized Spread	very small	68.08	123.54	55.46	72.53	117.42	44.89	74.60	120.95	46.35	76.23	105.91	29.68
	small	50.83	123.58	72.74	50.13	117.87	67.74	49.74	114.24	64.49	51.00	100.60	49.60
	medium	41.15	83.31	42.16	208.9	82.97	-125.91	295.7	243.39	-52.26	230.4	91.19	-139.19
	large	18.96	19.26	0.30	-22.9	26.54	49.48	-47.68	73.67	121.4	-29.38	67.48	96.75
	very large	11.54	29.70	18.15	12.49	28.20	15.71	12.22	34.77	22.55	12.61	31.34	18.73
	OVERALL	25.77	81.31	55.54	26.12	77.42	51.30	25.73	108.62	82.89	26.47	81.98	55.51

Data set includes all trades between 1/9/98 and 1/9/99. Trades were excluded if reported late or if the trade price was outside of the spread by more than 10%. Trading volume was averaged over the year. Price and market cap figures were taken as at 1/9/98. Industry specific stocks were matched by sub sector if possible, and by sector if not. Duplicates were removed (keeping the pair with the lowest "average deviation"). Figures are quoted in basis points.

Table 4: Trading cost measures for FTSE 250 stocks, split by trading platform and size of trade

Size of Trade	Trading Platform	Quoted Spread		Effective Spread		Price Impact		Realized Spread	
	SETS SETS	83.53	84.04	79.31	72.98	31.91	31.73	79.31	72.98
OVERALL	SEAQ SETS	141.75	174.84	95.91	103.82	8.74	12.51	95.91	103.82
	SEAQ SEAQ	161.48	166.06	107.75	106.87	14.73	15.55	107.75	106.87
	SETS SETS			97.50	85.78	9.04	8.16	73.88	62.06
Very Small	SEAQ SETS			110.05	126.88	-17.49	4.09	127.55	122.79
	SEAQ SEAQ			125.26	122.97	5.22	3.89	120.04	119.09
	SETS SETS			88.30	76.03	25.85	25.03	49.11	37.05
Small	SEAQ SETS			105.72	117.67	-23.67	12.76	129.39	104.91
	SEAQ SEAQ			121.19	119.45	8.30	6.33	112.89	112.87
	SETS SETS			90.32	76.22	-149.25	23.77	216.21	36.84
Medium	SEAQ SETS			99.65	108.15	12.24	13.33	87.41	94.82
	SEAQ SEAQ			115.69	116.31	-4.38	13.55	120.07	102.76
	SETS SETS			81.54	72.24	82.37	35.96	-24.81	17.74
Large	SEAQ SETS			91.25	84.12	66.40	19.45	24.84	64.67
	SEAQ SEAQ			105.02	107.56	33.38	28.56	71.64	79.00
	SETS SETS			79.15	70.39	44.14	37.22	12.12	10.95
Very Large	SEAQ SETS			55.65	31.83	25.27	12.40	30.37	19.43
	SEAQ SEAQ			64.06	58.55	20.49	19.12	43.56	39.43

Table 5: Matched sample for Investment Trust Stocks

Stock	Price	Market Capitalization	Deviation	Price	Market Capitalization	Name	Sub sector	Sector
BANKERS INV.TST	2.39	2018.37	0.110	2.79	1891.25	MORRISON (WM)	Food & Drug Retailers	NC Services
CALEDONIA INV.	7.65	617.16	0.137	8.375	742	SETON SCHOLL	Health	NC Consumer Goods
CHARTER EURO.	4.805	324.47	0.049	5.175	317.1	GREENE KING	Leisure Entertainment & Hotels	C Services
EDIN.INV.TST.	4.43	1181.14	0.041	4.795	1183.71	SMITH(WH)GRP.	General Retailers	C Services
EDIN.US TRACKER	5.485	370.97	0.087	5.205	328.56	SPIRAX-SARCO	Engineering & Machinery	General Industries
ELECTRA INV.TST	5.48	933.87	0.038	5.525	1000.13	CAPITA GROUP	Support Services	C Services
FLEM.AMER.I.T.	6.075	362.09	0.104	7.29	352.41	VIRIDIAN GRP.	Electricity	Utilities
FLEM.O'SEAS	4.005	448.33	0.065	3.97	397.02	TRAVIS PERKINS	Construction & Building Materials	Basic Industries
FLEMING CONTL.	5.935	345	0.013	5.8	345.95	PSION	Electronic & Electrical Equipment	General Industries
FLEMING MERCTLE	3.175	456.65	0.051	3.285	488.47	F.I.GROUP	Support Services	C Services
FOR.&COL.IV.TST	1.8775	1679.05	0.282	2.525	1281.07	AVIS EUROPE	Transport	C Services
GOVETT STRAT.IT	3.71	340.61	0.023	3.66	351.94	MCKECHNIE	Aerospace & Defence	General Industries
HEND.SMALL COS.	2.265	373.33	0.019	2.32	368.18	BARRATT DEVEL.	Construction & Building Materials	Basic Industries
INVEST.CAP.GWTH	1.7	353.78	0.031	1.605	355.56	HEPWORTH	Construction & Building Materials	Basic Industries
MERC.EURO.PRIV.	1.465	610.79	0.061	1.38	573.43	ASHTEAD GRP.	Construction & Building Materials	Basic Industries
MERCHANTS TST	4.11	344.34	0.137	4.635	295.1	RM	Support Services	C Services
MURRAY INC.TST.	4.585	344.59	0.047	4.66	372.21	POWELL DUFFRYN	Diversified Industries	General Industries
MURRAY INTL.TST	4.35	450.73	0.077	3.825	462.54	LEX SERVICE		
RIT CAPITAL	3.295	540.42	0.032	3.26	512.8	CHARTER	Engineering & Machinery	General Industries
SCOT.AMER.INV.	2.1	416.47	0.021	2.125	404	CRODA INTL.	Chemicals	Basic Industries
SCOT.INV.TST.	3.605	860.25	0.051	3.495	801.51	MAN(ED&F)	Speciality & Other Finance	Financials
SCOT.MORTGAGE	3.58	1092.98	0.042	3.475	1154.24	HAMMERSON	Real Estate	Financials
WITAN INV.	3.655	332.9	0.088	3.59	389.72	ST.IVES	Media & Photography	C Services
	89.728	14798.29	1.605	92.765	14368.9			
	3.9012	643.403913	0.070	4.033261	624.7347826			

Table 6: Trading cost measures for investment trusts and matched companies

	Size of Trade	Investment Trusts	Matched Stocks	Difference
Quoted Spread	OVERALL	70.67	156.66	85.98
Effective Spread	very small	62.39	117.42	55.03
	small	58.26	114.50	56.24
	medium	55.84	111.16	55.32
	large	52.81	103.66	50.85
	very large	44.36	57.89	13.54
	OVERALL	54.93	100.55	45.62
Price Impact	very small	1.99	5.52	3.53
	small	1.76	10.93	9.17
	medium	2.30	18.14	15.84
	large	6.43	39.46	33.04
	very large	11.76	23.05	11.29
	OVERALL	3.83	20.38	16.55
Realized Spread	very small	60.40	111.90	51.50
	small	56.49	103.57	47.08
	medium	53.53	93.02	39.48
	large	46.38	64.20	17.81
	very large	32.60	34.84	2.25
	OVERALL	51.10	80.17	29.07

Data set includes all trades between 1/9/98 and 1/9/99. Trades were excluded if reported late or if the trade price was outside of the spread by more than 10%. Price and Market Capitalization figures were taken as at 1/9/98. Investment trust stocks were matched against other stocks by Market Capitalization and Price. Pairs were excluded if the average deviation was greater than 0.375. Figures are quoted in basis points.